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IS 10242-3-13 (1992): Electrical installations in ships,
Part 3: Equipment, Section 13: Single and multicore cables
with extruded solid insulation for rated voltage 0.6/1 kV
[ETD 20: Electrical Installation]



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Indian Standard

ELECTRICAL INSTALLATIONS IN SHIPS

PART 3 EQUIPMENT

**Section 13 Single and Multicore Cable with Extruded Solid Insulation for
Rated Voltages 0.6/1 kV — Specification**

UDC 621.315.21.027.2 : 629.12.066

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**BUREAU OF INDIAN STANDARDS
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NEW DELHI 110002**

FOREWORD

This Indian Standard (Part 3/Sec 13) was adopted by the Bureau of Indian Standards, after the draft finalized by the Electrical Equipment and Installations in Ships and Offshore Sectional Committee had been approved by the Electrotechnical Division Council.

This standard is one among the series of Indian Standards on Electrical Installation in Ships. This series will have the following parts:

- Part 1 General,
- Part 2 System design,
- Part 3 Equipment,
- Part 4 Installation and test of completed installations, and
- Part 5 Special features.

In Part 3, for ease in reference, Sections 10 to 19 have been reserved for low and medium voltage power cables while Sections 20 to 29 would deal with the telecommunication cables for use in ships.

This Indian Standard is being prepared with an object:

- to standardize cables whose safety and reliability are ensured when they are installed in accordance with the requirements of IS 10242 (Part 3/Sec 12) : 1986 'Specification for electrical installations in ships : Part 3 Equipment, Section 12 Choice and installations of cables for low-voltage system;
- to lay down standard manufacturing requirements and characteristics of such cables directly or indirectly bearing on safety; and
- to specify test methods for checking conformity with those requirements.

In preparing this Indian Standard, assistance has been derived from IEC 92-353 (1988) 'Electrical installation in ships : Part 353 Single and multicore cables with extruded solid insulation for rated voltage 0.6/1 kV', issued by the International Electrotechnical Commission (IEC).

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance, with IS 2 : 1960 'Rules for rounding off numerical values (revised)'. The number of significant places retained in the rounded off value, should be the same as that of the specified value in this standard.

*Indian Standard***ELECTRICAL INSTALLATIONS IN SHIPS****PART 3 EQUIPMENT****Section 13 Single and Multicore Cable with Extruded Solid Insulation for Rated Voltages 0.6/1 kV — Specification****1 SCOPE**

1.1 This standard (Part 3/Sec 13) applies to shipboard cables with extruded solid insulation having a voltage rating of 0.6/1 kV (*see* 4) and intended for fixed installation.

1.2 The various types of cables are given in 6.1. The construction requirements and test methods shall comply with those indicated in IS 10242 (Part 3/Sec 10) : 1990 unless otherwise specified in this standard.

2 REFERENCES

2.1 The Indian Standards listed in Annex A are necessary adjuncts to this standard.

3 DEFINITIONS

3.1 For the purpose of this standard, the terms and definitions given in IS 10242 (Part 3/Sec 10) : 1990, shall apply.

4 GENERAL REQUIREMENTS**4.1 Rated Voltage**

4.1.1 The standard rated voltages U_0/U of the cables considered in this standard are as follows:

$$U_0/U = 0.6/1 \text{ kV ac}$$

where

U_0 = is the rated power-frequency voltage between the conductor and the earth or metallic covering for which the cable is designed, and

U = is the rated power-frequency voltage between conductors for which the cable is designed.

DC voltage up to a maximum of 1.5 times the ac voltage may be used, provided that the voltage to earth does not exceed 0.9 kV.

4.2 Types of Insulating Compounds

4.2.1 The insulating compounds and their designations shall be as given in IS 10242 (Part 3/Sec 11) : 1986.

4.3 Types of Sheathing Compounds

4.3.1 The sheathing compounds and their designations shall be as given in IS 10242 (Part 3/Sec 19) : 1990.

5 MARKING**5.1 Indication of Origin**

Cables shall be provided with an indication of origin, consisting of an identification thread, or a tape (either longitudinal or lapped), or a continuous marking of the manufacturer's name or trade-mark. This marking may be done by printing on, or embossing, the insulation or the sheath.

5.2 Continuity

The marking of the manufacturer's name or trade-mark is deemed to be continuous if the distance between the end of any marking and the beginning of the next does not exceed:

- 50 cm if the indication is on the sheath, and
- 20 cm in all other cases.

5.3 Durability

The printed marking shall be indelible. Compliance with this requirement is checked by the test described in 7.1.2.

5.4 Legibility

The marking of the manufacturer's name or trade-mark, voltage grade and year of manufacturer shall be legible.

The colours of identification threads shall be easy to recognize or easily made recognizable, if necessary, by cleaning with petrol.

5.5 Core Identification

Cores of cables shall be provided with a suitable method of identification, either by using numbered tape or coloured tape on the cores. Printing of numbers on the insulation of the cores or adopting different combination of colours for cores is also considered appropriate.

6 CONSTRUCTION REQUIREMENTS

6.1 General Description

6.1.1 Shipboard cables 0.6/1 kV for fixed installations for power, lighting and similar systems shall consist of copper conductors insulated with ethylene propylene rubber (EPR), cross-linked polyethylene (XLPE) or polyvinyl chloride (PVC), twisted together, with an inner covering, if any, one or two sheaths and, optionally, a metal armour.

6.1.2 For the outer protection of the cores, the following types of constructions are permitted:

- a single sheath of polychloroprene, or chlorosulphonated polyethylene, or chlorinated polyethylene, or polyvinyl chloride;
- an inner sheath of polychloroprene, or chlorosulphonated polyethylene, or chlorinated polyethylene, and an outer sheath of polyvinyl chloride;
- a copper braid over an inner covering with an outer single sheath of polychloroprene, or chlorosulphonated polyethylene, or chlorinated polyethylene, or polyvinyl chloride;
- a single sheath of polychloroprene, or chlorosulphonated polyethylene, or chlorinated polyethylene, or polyvinyl chloride with an outer metal braid; and
- an inner sheath of polychloroprene, or chlorosulphonated polyethylene, or chlorinated polyethylene, or polyvinyl chloride, a metal armour and an outer sheath of polychloroprene, or chlorosulphonated polyethylene or chlorinated polyethylene, or polyvinyl chloride.

6.1.3 A PVC inner sheath is not recommended where the outer sheath consists of a vulcanized material.

NOTE — Cables for installation in spaces where corrosion may occur, for example, weather decks, wet locations, battery compartments, refrigeration rooms, etc., should have an outer sheath over the braid, if any, unless the braid itself is corrosion-resistant.

6.2 Conductors

6.2.1 The material, metal coating, separator, class and form of the conductors shall be in accordance with IS 10242 (Part 3/Sec 10) : 1990.

6.3 Insulation

6.3.1 Electrical and non-electrical characteristics of insulation shall be as specified in IS 10242 (Part 3/Sec 11) : 1986.

6.3.2 Application to the Conductor

The insulation shall be applied closely to the conductor or to the separator, if any. It shall be possible to remove the insulation without damaging the conductor or the metal coating, if any.

Compliance shall be checked by visual inspection.

6.3.3 Thickness of Insulation

The average thickness shall be not less than the value specified in Table 1 for each type of insulation and cross-section of conductor.

The thickness at any point may be less than the specified value, provided the difference does not exceed 0.1 mm + 10 percent of the specified value.

The thickness of any separator on the conductor or over the insulation shall not be included in the thickness of the insulation.

Table 1 Specified Thickness of Insulation

(Clause 6.3.3)

Nominal Cross Sectional Area of Conductor	PVC/A	EPR	XLPE
(mm ²)	(mm)	(mm)	(mm)
(1)	(2)	(3)	(4)
1.5	0.8	1.0	0.7
2.5	0.8	1.0	0.7
4	1.0	1.0	0.7
6	1.0	1.0	0.7
10	1.0	1.0	0.7
16	1.0	1.0	0.7
25	1.2	1.2	0.9
35	1.2	1.2	0.9
50	1.4	1.4	1.0
70	1.4	1.6	1.1
95	1.6	1.6	1.1
120	1.6	1.6	1.2
150	1.8	1.8	1.4
185	2.0	2.0	1.6
240	2.2	2.2	1.7
300	2.4	2.4	1.8

6.4 Cabling

Cores of a multicore cable shall be laid up, and interstices filled with fillers or inner covering according to 6 of IS 10242 (Part 3/Sec 10) : 1990.

6.5 Inner Covering, Fillers and Binder

6.5.1 General

The inner covering, if any, may be extruded or lapped.

The relevant material and characteristics shall be in accordance with 7 of IS 10242 (Part 3/Sec 10) : 1990.

Compliance with this requirement is checked by the test specified in 7.2.5 (c).

6.5.2 Thickness of Inner Covering

The approximate values of the thickness of extruded or lapped inner coverings are as given in Table 2 below.

The approximate thickness of a lapped covering is 0.4 mm for fictitious diameters over laid-up cores up to and including 40 mm, and 0.6 mm for larger diameters.

NOTE — For the calculation of fictitious diameters see Annexes B and C of IS 10242 (Part 3/Sec 10) : 1990.

6.6 Non-metallic Sheath

6.6.1 Electrical and non-electrical characteristics of the sheathing materials shall be as specified in IS 10242 (Part 3/Sec 19) : 1990.

6.6.2 Thickness of Sheath(s)

The thickness of outer sheaths and of inner sheath, if any, are given as a function of the internal diameter of the sheath under consideration, this fictitious diameter being calculated by the method outlined in Annexes B and C of IS 10242 (Part 3/Sec 10) : 1990.

Table 2 Specified Thickness of Extruded Inner Covering
(Clause 6.5.2)

Fictitious Diameter Over Laid-Up Cores		Thickness of Extruded Inner Covering (Approximate Value)
Above	Up to and Including	
All dimensions in millimetres.		
—	25	1.0
25	35	1.2
35	45	1.4
45	60	1.6
60	80	1.8
80	—	2.0

The formulae are:

- a) for armoured or unarmoured single sheathed cables:

$$t_1 = 0.04 D + 0.8 \text{ mm with a minimum thickness of } 1.0 \text{ mm}$$

(D = fictitious diameter under the sheath)

- b) for unarmoured double sheathed cables:

$$\text{— inner sheath } t_1 = 0.025 D + 0.6 \text{ mm with a minimum thickness of } 0.8 \text{ mm}$$

$$\text{— outer sheath } t_2 = 0.025 D + 0.9 \text{ mm with a minimum thickness of } 1.0 \text{ mm}$$

- c) for armoured double sheathed cable:

$$\text{— inner sheath } t_1 = 0.04 D + 0.8 \text{ mm with a minimum thickness of } 1.0 \text{ mm}$$

$$\text{— outer sheath } t_2 = 0.025 D + 0.6 \text{ mm with a minimum thickness of } 0.8 \text{ mm}$$

The mean value of the thickness and the thickness at any point shall satisfy the requirements given in 8.6.2 of IS 10242 (Part 3/Sec 10) : 1990.

6.6.3 Colour of Sheath

The sheath shall be coloured black or grey.

6.7 Armour

6.7.1 General

In this standard, only metal braid armours are specified, the braid wires being of copper, copper alloy, aluminium alloy or galvanized steel.

The risk of corrosion shall be considered when aluminium alloys are used.

Joints in the braiding wires shall be soldered, twisted or woven in and the complete braid shall not be welded. The braid shall be evenly applied.

Galvanized steel wire, strip or tape armour is permitted, but their dimensions are subject to agreement between the manufacturer and the purchaser.

6.7.2 Braid Wire Diameter

Irrespective of the metal used, the nominal diameter of the braid wire shall be:

0.2 mm for cable diameters under the braid less than or equal to 10 mm;

0.3 mm for cable diameters under the braid greater than 10 mm and less than or equal to 30 mm; and

0.4 mm as a minimum, for cable diameters under the braid greater than 30 mm.

6.7.3 Coverage Density

The coverage density of the braid shall be in accordance with **8.2** of IS 10242 (Part 3/ Sec 10) : 1990.

The fictitious diameter under the braid is calculated by the method described in Annex B of IS 10242 (Part 3/Sec 10) : 1990.

6.7.4 Application of Armour

The armour shall be applied in such a way that it shall adhere neither to the inner covering or inner sheath nor to the outer sheath.

7 TEST REQUIREMENTS

7.1 Particular Tests

7.1.1 Compatibility Test Between Conductor and Insulation

For cables with elastomeric insulation where non-coated copper conductors with or without separator are used, a compatibility test shall be carried out on a completed core.

The test conditions and final requirements are under consideration.

7.1.2 Durability

Compliance with the requirements of **5.3** is checked by trying to remove the marking of the manufacturer's name or trade-mark and the colour of the cores by rubbing them lightly ten times with a piece of cotton wool or cloth soaked in water.

7.2 Tests on Completed Cables

7.2.1 For these tests, reference is made to the relevant clauses of IS 10242 (Part 3/Sec 10) : 1990.

For test methods for insulations and sheaths, reference should be made to relevant parts of IS 10810 series.

7.2.2 Routine Tests

- a) Measurement of electrical resistance of conductors [*see* **10.2** of IS 10242 (Part 3/ Sec 10) : 1990];

- b) High Voltage test [*see* **10.3** of IS 10242 (Part 3/Sec 10) : 1990]; and
- c) Insulation resistance test [*see* **10.4** of IS 10242 (Part 3/Sec 10) : 1990].

7.2.3 Special Tests

- a) Conductor examination [*see* **11.3** of IS 10242 (Part 3/Sec 10) : 1990];
- b) Check of cable dimensions [*see* **11.4, 11.5, 11.6** and **11.7** of IS 10242 (Part 3/ Sec 10) : 1990];
- c) Hot set test for EPR and XLPE [*see* **11.8** of IS 10242 (Part 3/Sec 10) : 1990];
- d) Test at low temperature for PVC [*see* **11.9** of IS 10242 (Part 3/Sec 10) : 1990]; and
- e) Coverage density of the braid [*see* **11.6** (b) of IS 10242 (Part 3/Sec 10) : 1990].

7.2.4 Type Tests, Electrical

- a) Insulation resistance measurement at room temperature [*see* **12.2.1** of IS 10242 (Part 3/Sec 10) : 1990];
- b) Insulation resistance measurement at maximum rated temperature [*see* **12.2.2** of IS 10242 (Part 3/Sec 10) : 1990];
- c) Increase in ac capacitance after immersion in water [*see* IS 10242 (Part 3/ Sec 10) : 1990]; and
- d) High-voltage test for 4 h [*see* **12.4** of IS 10242 (Part 8/Sec 10) : 1990].

7.2.5 Type Tests, Non-electrical

- a) Measurement of thickness of insulation [*see* **13.1** of IS 10242 (Part 3/Sec 10) : 1990];
- b) Measurement of thickness of sheath [*see* **13.2** of IS 10242 (Part 3/Sec 10) : 1990];
- c) Non-electrical characteristics of insulation [*see* **13.3** and **13.6** to **13.11** of IS 10242 (Part 3/Sec 10) : 1990];
- d) Non-electrical characteristics of sheaths [*see* **13.4, 13.6, 13.9** and **13.12** of IS 10242 (Part 3/Sec 10) : 1990];
- e) Additional ageing test on pieces of completed cable [*see* **13.5** of IS 10242 (Part 3/Sec 10) : 1990]; and
- f) Flame retardance test [*see* **13.13** of IS 10242 (Part 3/Sec 10) : 1990].

ANNEX A(*Clause 2.1*)**LIST OF REFERRED INDIAN STANDARDS**

<i>IS No.</i>	<i>Title</i>	<i>IS No.</i>	<i>Title</i>
10810 <i>series</i>	Methods of tests for cables		Section 11 Insulating materials for shipboard power cables
10242 (Part 3/ Sec 10) : 1990	Electrical installations in ships : Part 3 Equipment, Section 10 General construction and test requirements for low voltage shipboard power cables	10242 (Part 3/ Sec 19) : 1990	Electrical installations in ships : Part 3 Equipment, Section 19 Sheathing Materials for telecommunication and power shipboard cables
10242 (Part 3/ Sec 11) : 1986	Electrical installations in ships : Part 3 Equipment,		

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